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Design and Development of Measuring Device in Automobiles during Fueling

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Abstract: *Automobiles are playing an important role in our day to day life and fuel is the soul of these automobiles. The demand for the fuel has been increasing and the fuel theft in vehicles also has been increasing. Even, in petrol bunks fuelling process is not done properly. Some of fuel bunks involves cheating by not properly filling the correct volume of fuel for the given cost. In market already there are various types of monitoring systems are available, but are not accurate as well as cheap. So, a new cost effective portable fuel monitoring system is proposed in this research work without doing any modification in existing vehicle fuel casing. The proposed system has two salient features i.e., fuel theft and fuel addition process are intimated through message to a specified mobile. This product can be implemented in all type of vehicles with varying the reference level as the size of the tank varies with respect to vendor and type.*

Keywords: *Capacitance effect, Atmega16 controller, fuel monitor, fuel theft*

1. INTRODUCTION

The "capacitance fuel level sensor without any moving part" is used for measuring the fuel level in the fuel tanks of vehicles. It works on the principle of capacitance effect. Depending upon the level of the liquid the capacitance varies in nano farads, which in turn produces changes in the value of current in mill amperes. This can be done by the controller that internally calculates the change in frequency to the change in capacitance value and produce an analog voltage. The calibration of the sensor is also done by the controller, which frequently monitors the change in capacitance values.

2. Description

2.1 Capacitive Liquid Level Sensors

The principle behind the measuring of volume of the fuel by Capacitive Liquid Level Sensors is capacitance effect. The measurement process is "the fuel acts as the dielectric medium between the electrodes, as the fuel level increases, the capacitance value also increases".

The capacitance level detector consists of two conductors, which are electrically separated. When these two conductors are at different potentials, the system is capable of storing an electric charge. It works by measuring the change in capacitance between the two conducting surfaces of the inner and outer tubes.

If the area (A) and the distance (D) between the plates of a capacitor remain constant, capacitance will vary only as a function of the

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dielectric constant of the substance filling the gap between the plates. If a change in level causes a change in the total dielectric of the capacitance system, because the lower part of area (A) is exposed to a liquid (dielectric K) while the upper part is in contact with air (dielectric K, which is close to 1.0), the capacitance measurement will be proportional to level. The increase in the capacitance is directly proportional to increase in the fuel level. The storage capability of a capacitor is measured in farads. This sensor is mainly used for its accuracy.

Fig 1. Capacitive level sensor

Capacitance C is calculated as C = k (A/D)
where k = dielectric constant of the medium (For diesel dielectric constant is 4)

D = distance between the plates in mm
A = area of the plates in mm2

MATERIAL	**DIELECTRIC CONSTANT**
Air	1
Diesel	4
Petroleum	2.0 to 2.2
Transformer Oil	2.2
Acetic Acid	4.1
Glass	3.7
Castor Oil	4.7
Paper Dry	2.0
Mineral Oil	2.1
Water	4 t0 88
Teflon	2.0
Quartz	4.0

Fig 2. Dielectric constant of different liquids

2.2 GPS Module

A system that allows small electronic devices to determine their location (Longitude, Latitude and Altitude) as well as time with an accuracy of up to few centimeters using time signals transmitted along a line of sight by radio from satellite. In the system, the GPS module sends information about the location of the vehicle at present and sends the information to the concerned person.

2.3 GSM Module

A GSM module is a specialized type of module, it accepts a SIM card and operates over a subscription to a mobile operator just like a mobile phone and sends messages to the concerned person, regarding the fuel level and location of the vehicle.

2.4 LCD Display

LCD: Liquid Crystal Display is used to display the preset words, digits in 7-segment displays as in a digital clock. In the system LCD display is used to display the fuel level in litres to the driver of the vehicle.

2.5 Microcontroller

All the functions of this system are carried out by Atmega16 controller. It has multiple serial interfaces including two UARTs, with the help of that we can interface both GSM and GPS module to the controller. It also has the USB2.0 support which will be helpful in storing the continuous data in the pen drive or any other external storage devices. It is well suited for the future up gradations.

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Fig 3.Atmega 16 controller

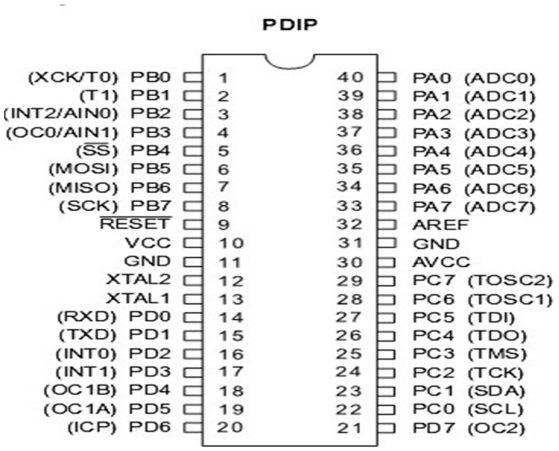

Fig 4. Atmega 16 controller pin diagram

2.6 Features of Atmega16

- High Performance, Low Power Atmel®AVR® 8-bit Microcontroller
- Advanced RISC Architecture
- Data and Non-Volatile Program Memory
- 16/32/64K Bytes Flash of In-System Programmable Program Memory
- 512B/1K/2K Bytes of In-System Programmable EEPROM
- 1/2/4K Bytes Internal SRA
- Write/Erase Cycles: 10,000 Flash/ 100,000 EEPROM
- Data Retention: 20 years at 85°C/ 100 years at 25°C
- Programming Lock for Flash Program and EEPROM Data Security
- Direct Power Supply Voltage Measurement
- 10-bit DAC for Variable Voltage Reference (Comparators, ADC)
- Operating Voltage: 2.7V - 5.5V
- Extended Operating Temperature:
- -40°C to +85°C

3. Fuel Monitoring

Whenever fuel is added there will be a change in voltage which is detected by the capacitive sensor in the fuel tank. The voltage change is shown in the digital display in the vehicle. This voltage change is measured and reported to the concerned person whenever the lid of the fuel tank is opened and closed. By this way, it is possible to calculate the intermediate level of fuel in the tank. With the output current from the sensor, it is possible to calculate the accurate volume of the tank too.

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S. No.	Fuel Volume in tank	Change in current (mA)
1.	Empty	20
2.	Full	4

Table 1. Relationship between fuel volume and change in current

4. Implementation Diagram

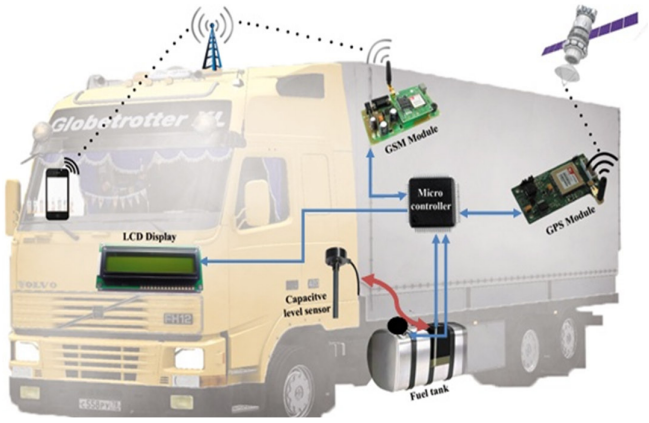

Fig.5.Implementation diagram

The capacitive fuel level sensor is fixed inside the fuel tank whose output is given to the microcontroller (Atmega16).The GSM SIM 900 module and GPS module is connected to the tx1,rx1 and tx2,rx2 of the controller. A switch is placed over the lid of the fuel tank to monitor opening and closing of fuel tank, which in turn acts as a trigger to the controller. For the manual verification LCD display is fixed inside the truck cabin, it denotes the amount of the fuel added in the tank. The GPS module navigates the current location of the vehicle with the help satellite communication and the GSM SIM 900 module is used to send message to the specified mobile number, which has been predefined in the micro controller.

6. Flow Chart

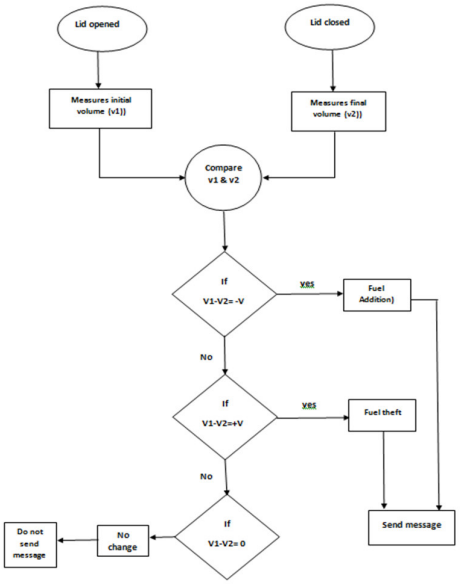

Fig.6.Flow Chart

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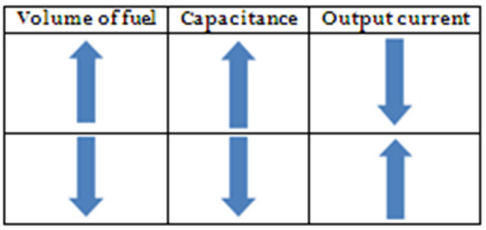
The processes involved are:

- When the lid is opened, the sensor measures the current fuel level in the tank and stores the value in the counter.
- When the lid is closed, the sensor once again measures the fuel level and stores the value in another counter.
- Both the counter values are compared in the micro-controller and the difference value is found.
- If the value is negative, it indicates the fuel addition and a message is sent along with the location of the vehicle.
- If the value is positive, it indicates the fuel theft and a message is sent along with the location of the vehicle.
- If the value is zero, then it indicates that there is no change in the fuel level, so message is not sent.

7. Process Description

- When the volume of the fuel in tank increase, capacitance of the sensor increases so output current decreases.
- When the volume of the fuel in tank decreases, capacitance of the sensor decreases so output current increases.

Table 2. Relationship between volume of fuel, capacitance and current



8. Conclusion

From the above findings and our experimental study we have found that the capacitive liquid level measurement is too accurate than all other types. We can measure accurately the volume of fuel in litres by this way we can monitor the fuel theft as well as the exact volume of fuel addition in vehicles.

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